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(54) Printing unit for flying plate exchange

(57) A printing unit for flying plate exchange of a web offset rotary printing machine is provided with two transfer cylinders 5; 6 coating a printing material web 7 fed between them with ink and two forme cylinders 3; 4 each co-operating with one of the transfer cylinders and fitted with exchangeable plates. The cylinders, even when at a distance from each other in the printing-off configuration, are synchronously drivable. For ensuring the preservation of the printing points on the printing material web during flying plate exchange and the greatest possible uniformity of configurations of printing units designed for flying plate exchange or otherwise, as well as for an economical use of the unit in both types of operation, at least one forme cylinder 3 of the associated transfer cylinder 5 is pivotable into a position enabling plate exchange, and is drivable and stoppable separately from the drive of the other printing unit cylinders, and the corresponding transfer cylinder 5 in the plate exchange position 9 of the forme cylinder 3 acts as an impression cylinder 10 for the other transfer cylinder 6, to this end being synchronously drivable with the corresponding forme cylinder 4.

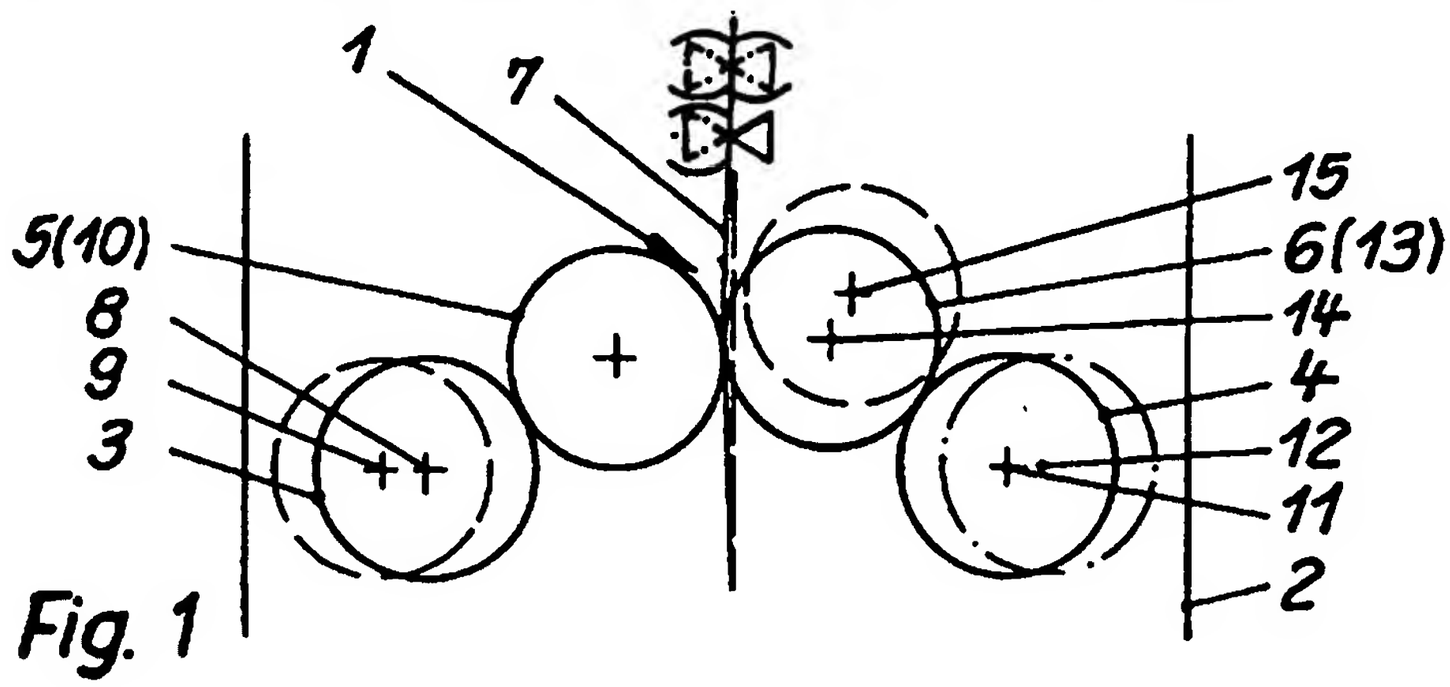

Fig. 1

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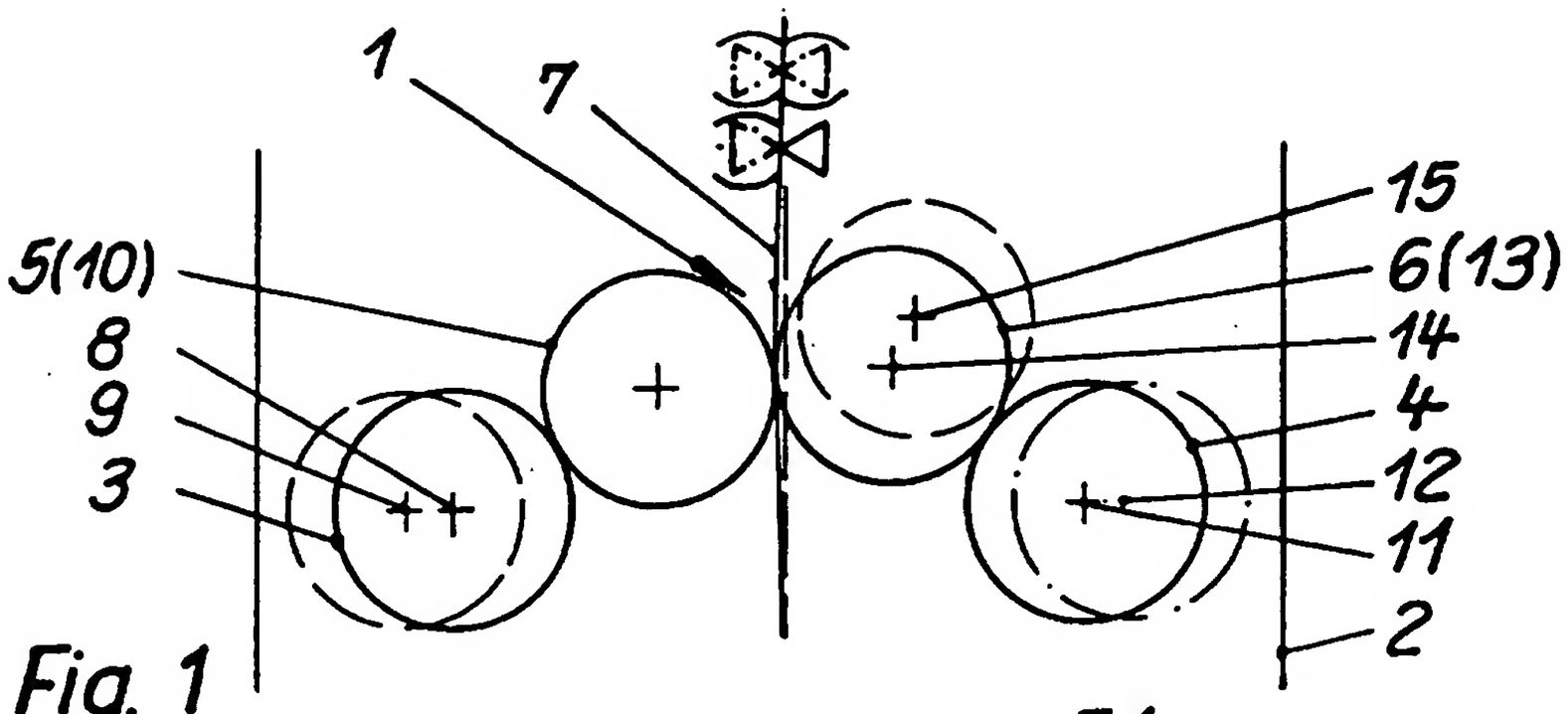


Fig. 1

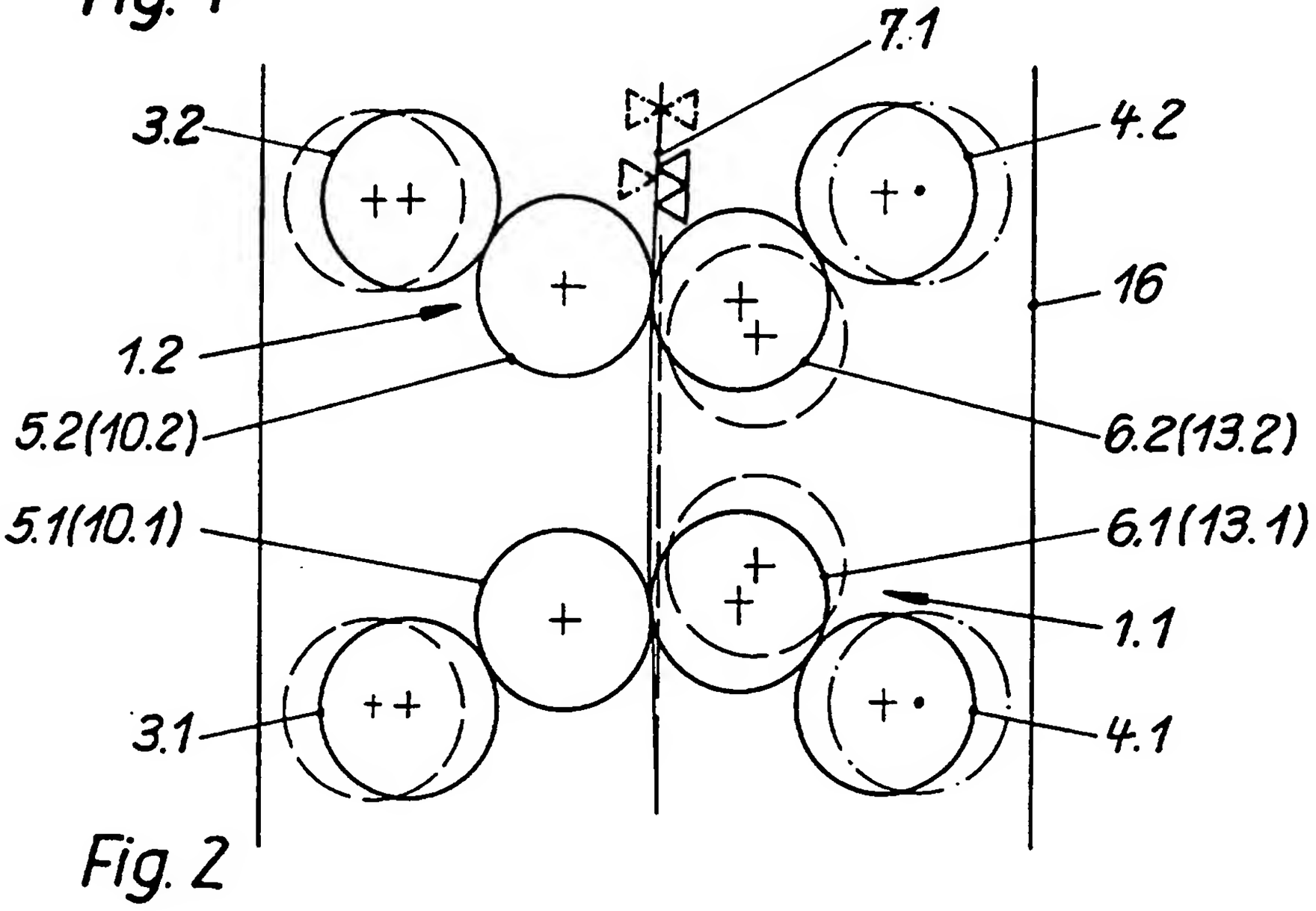


Fig. 2

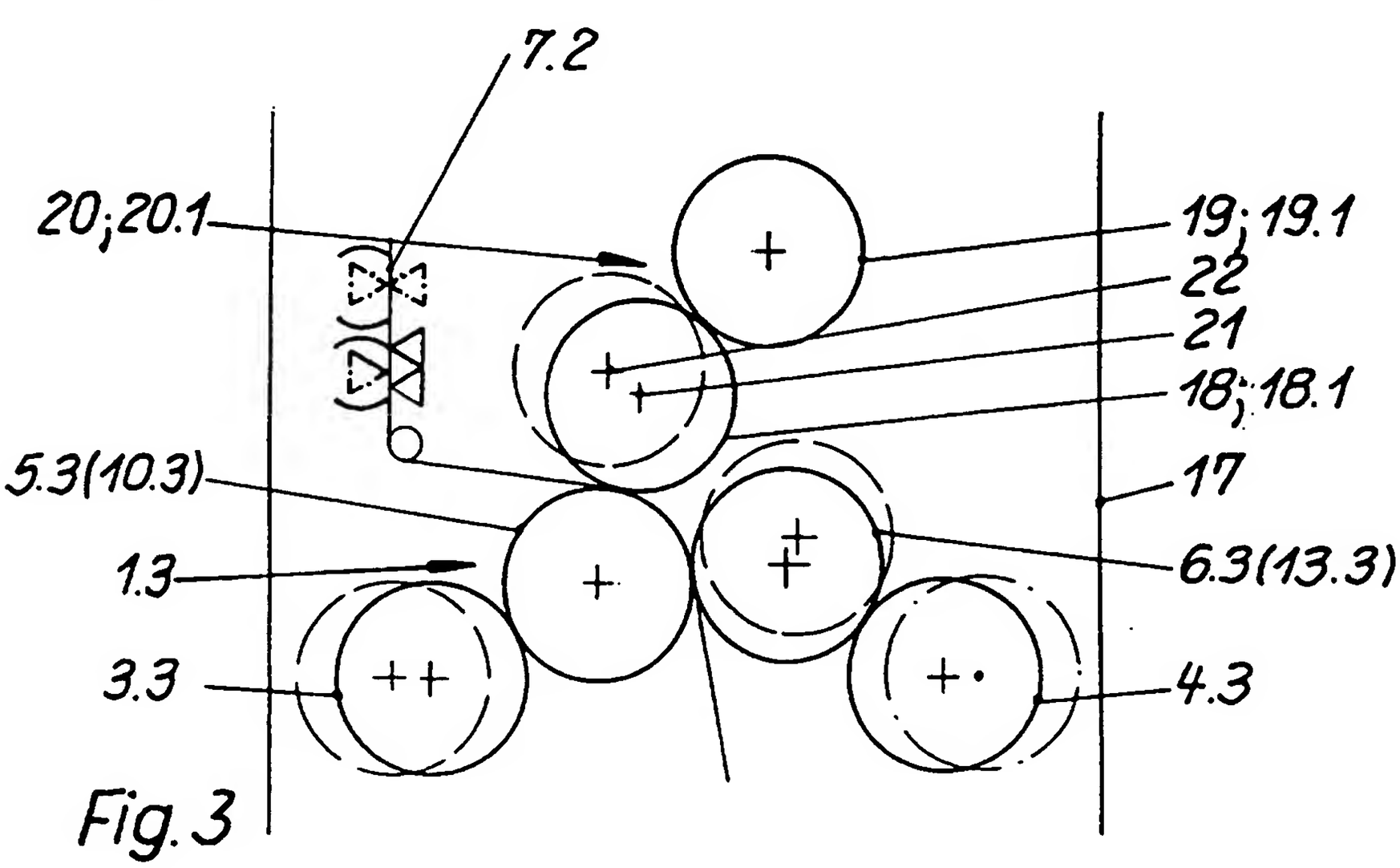


Fig. 3

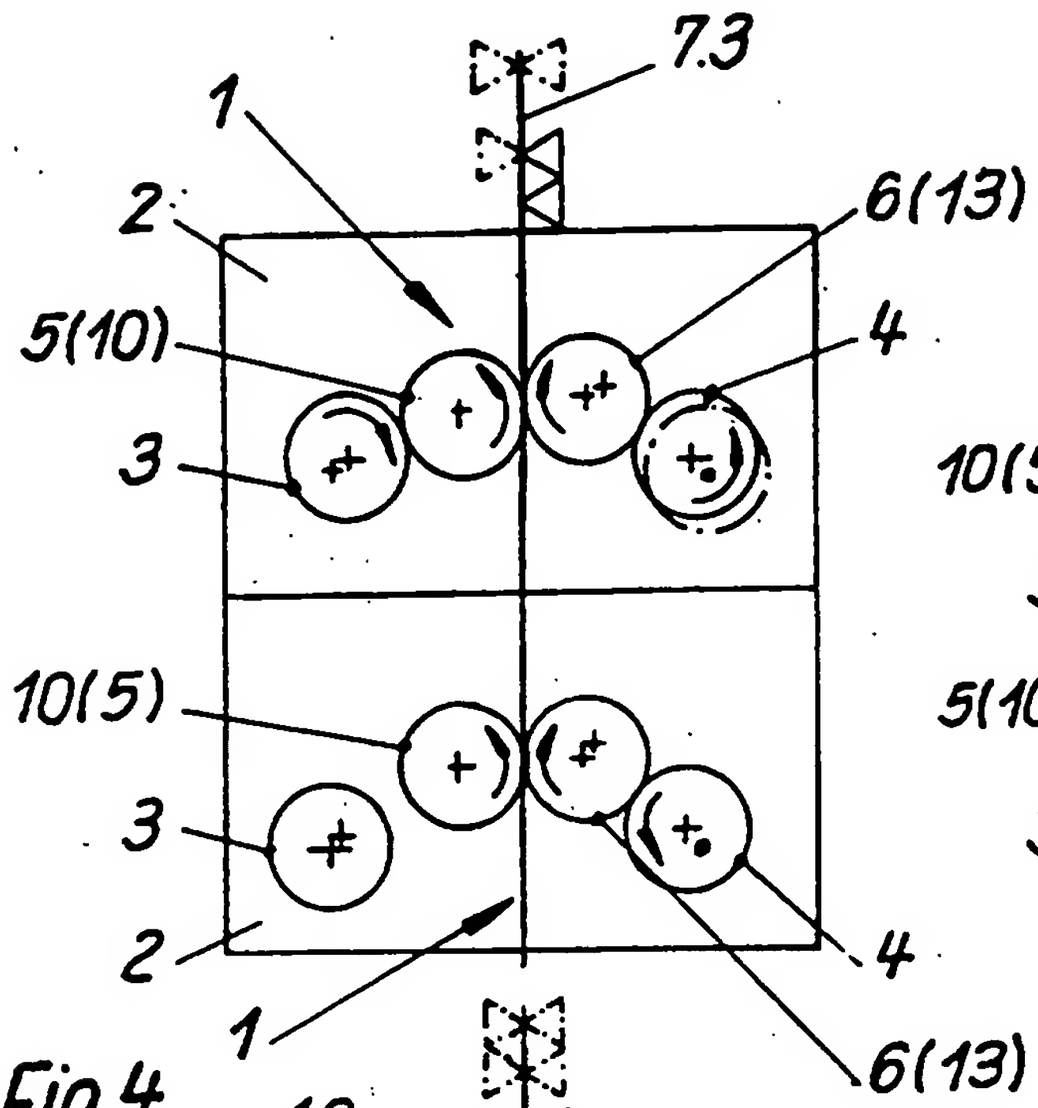


Fig.4

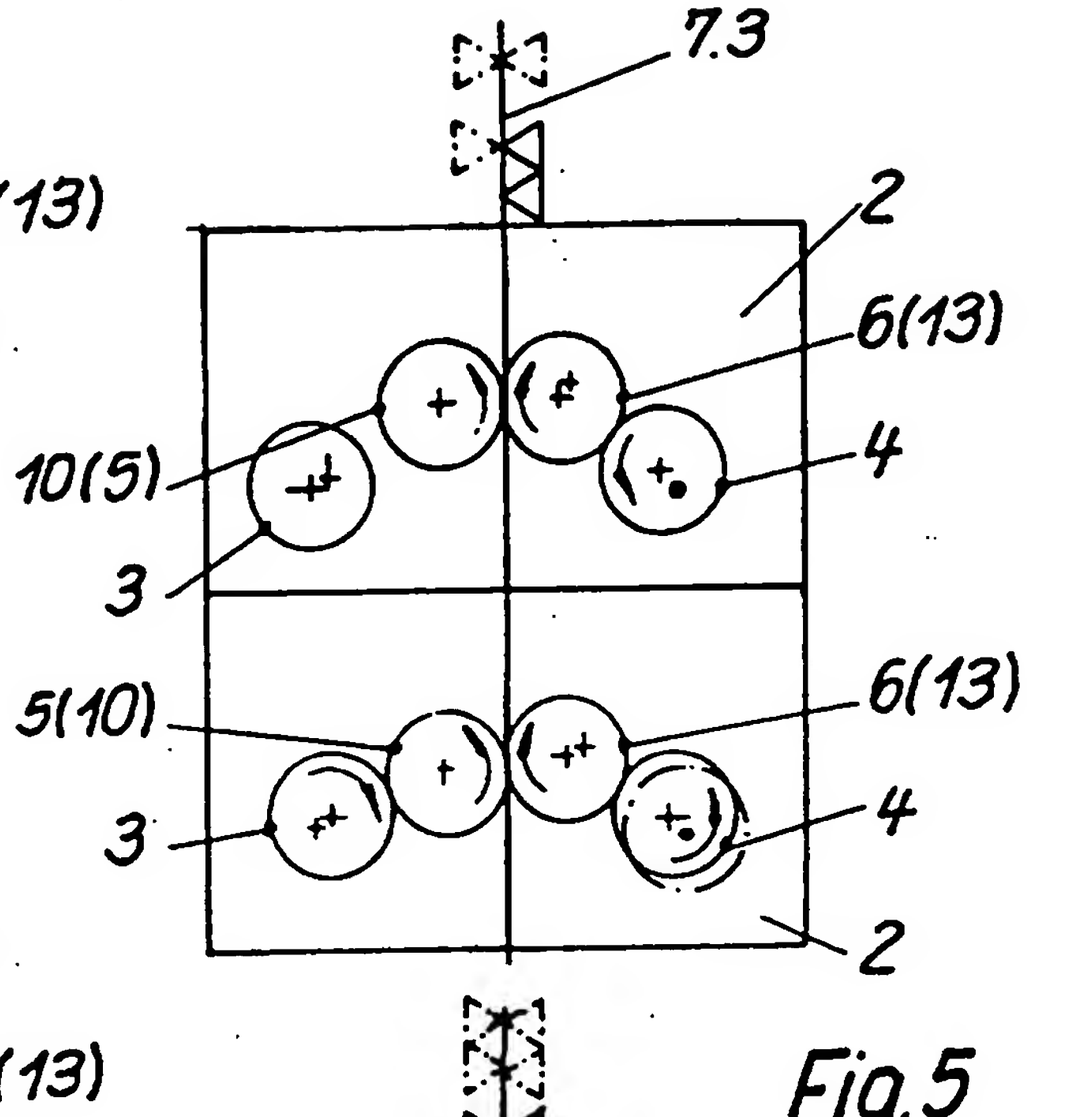


Fig.5

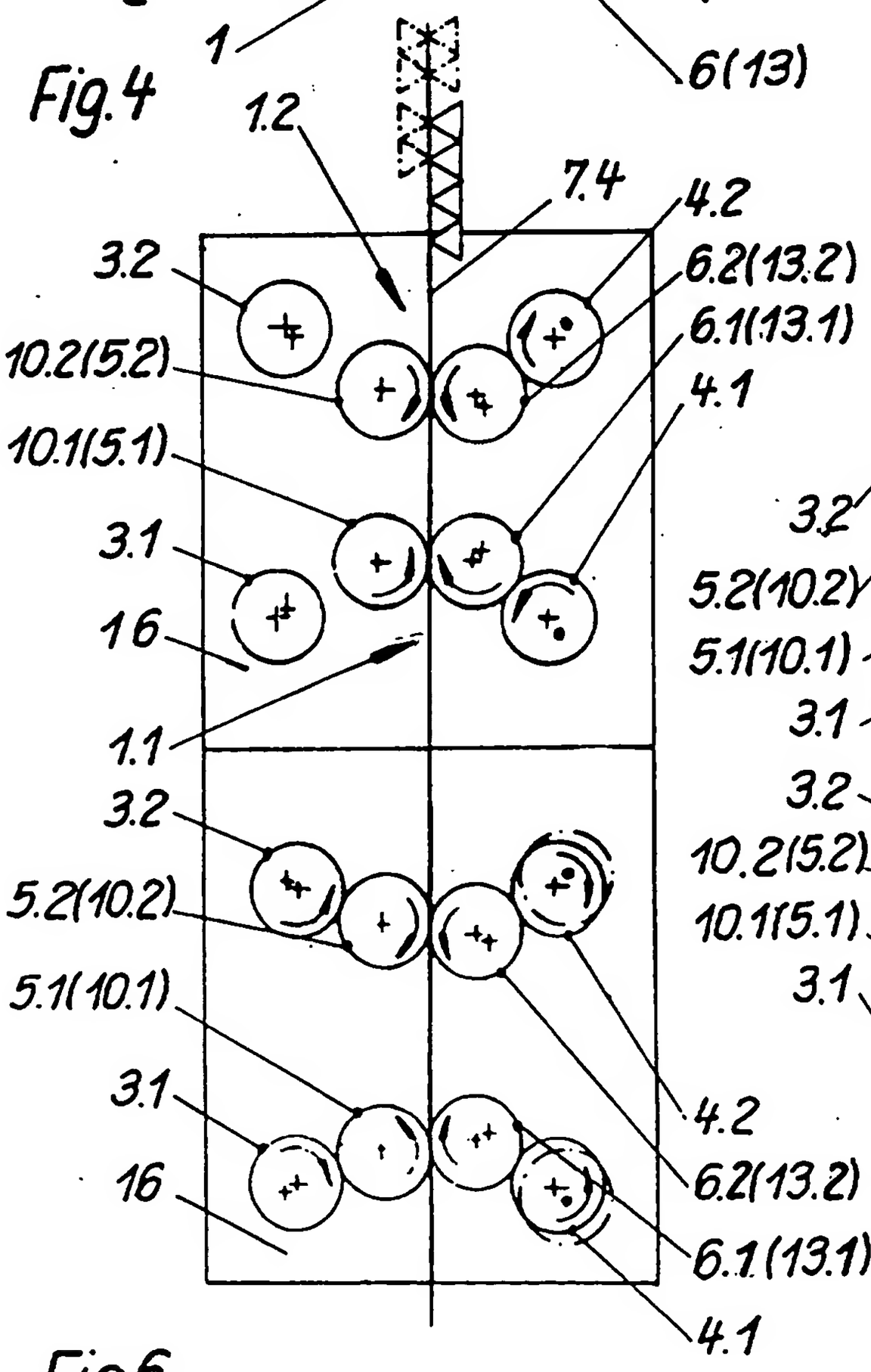


Fig.6

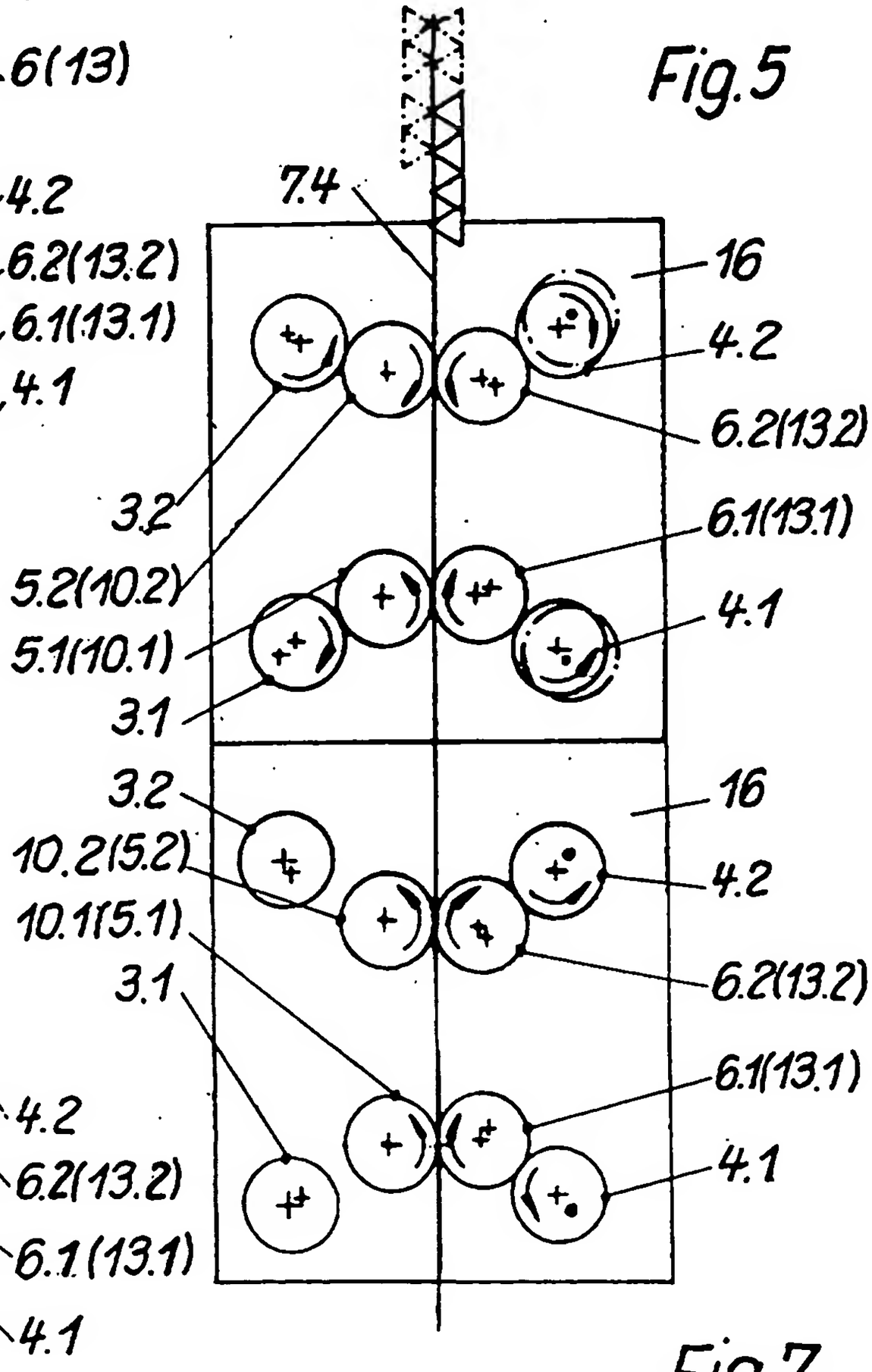


Fig.7

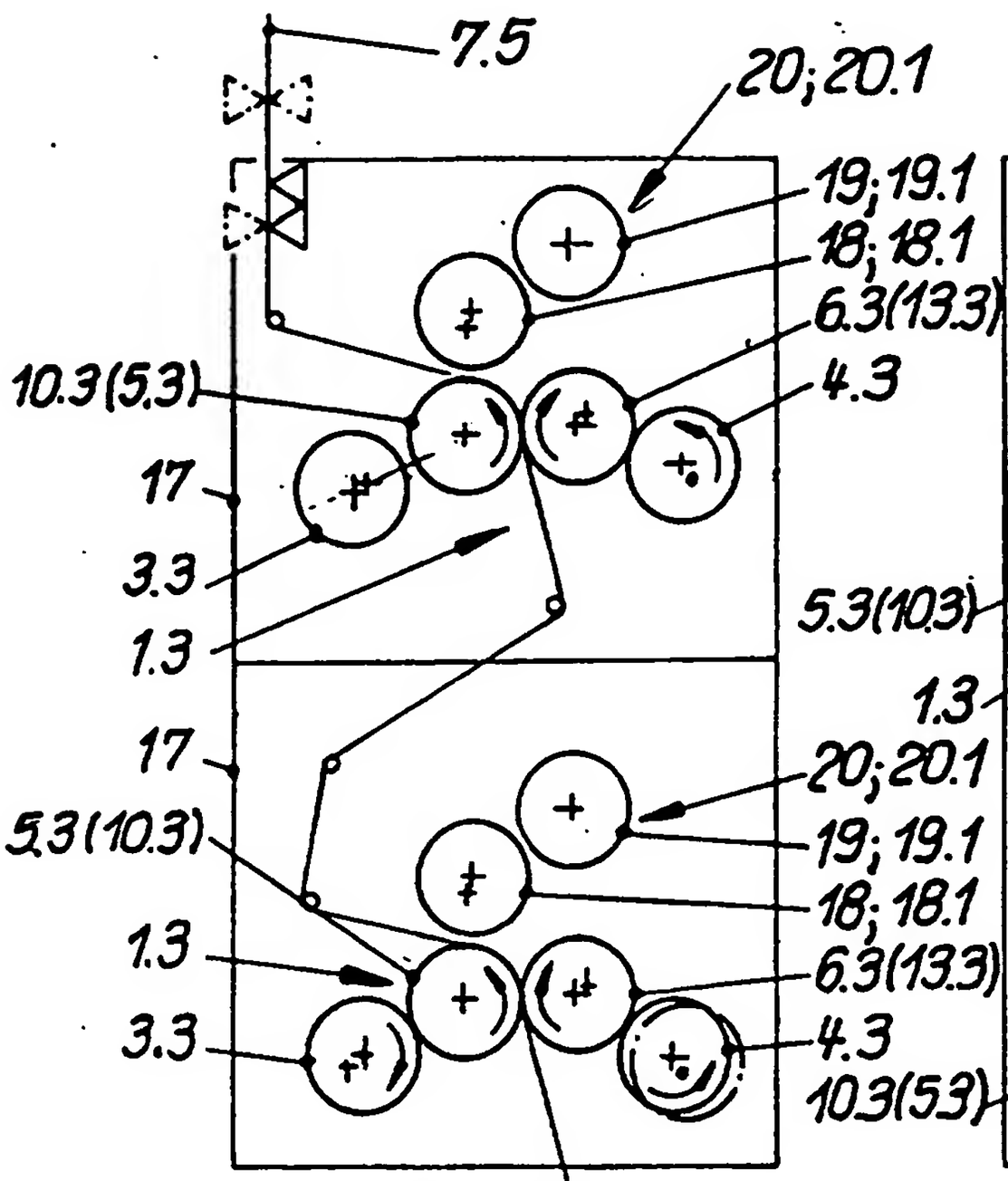


Fig.8

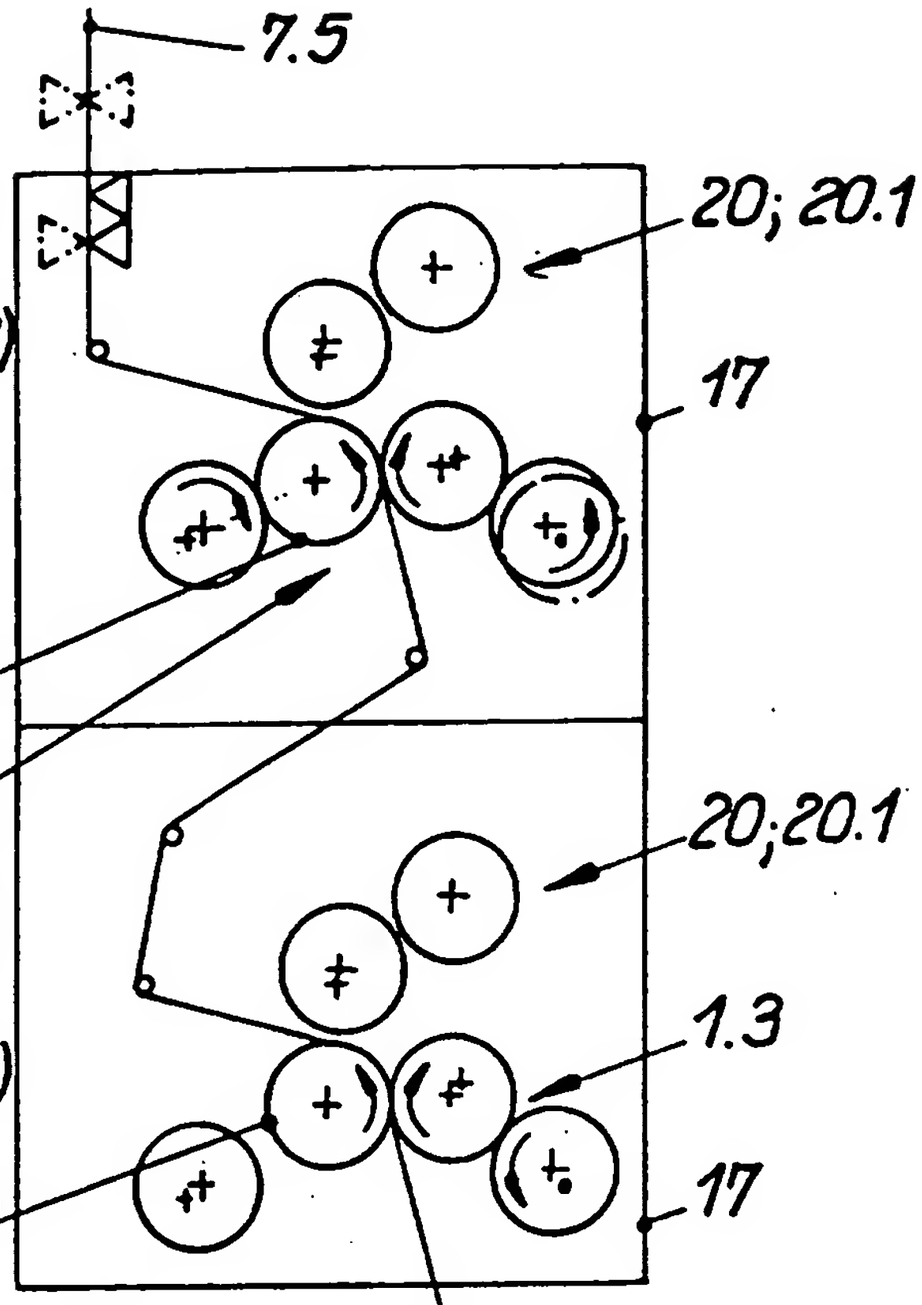


Fig.9

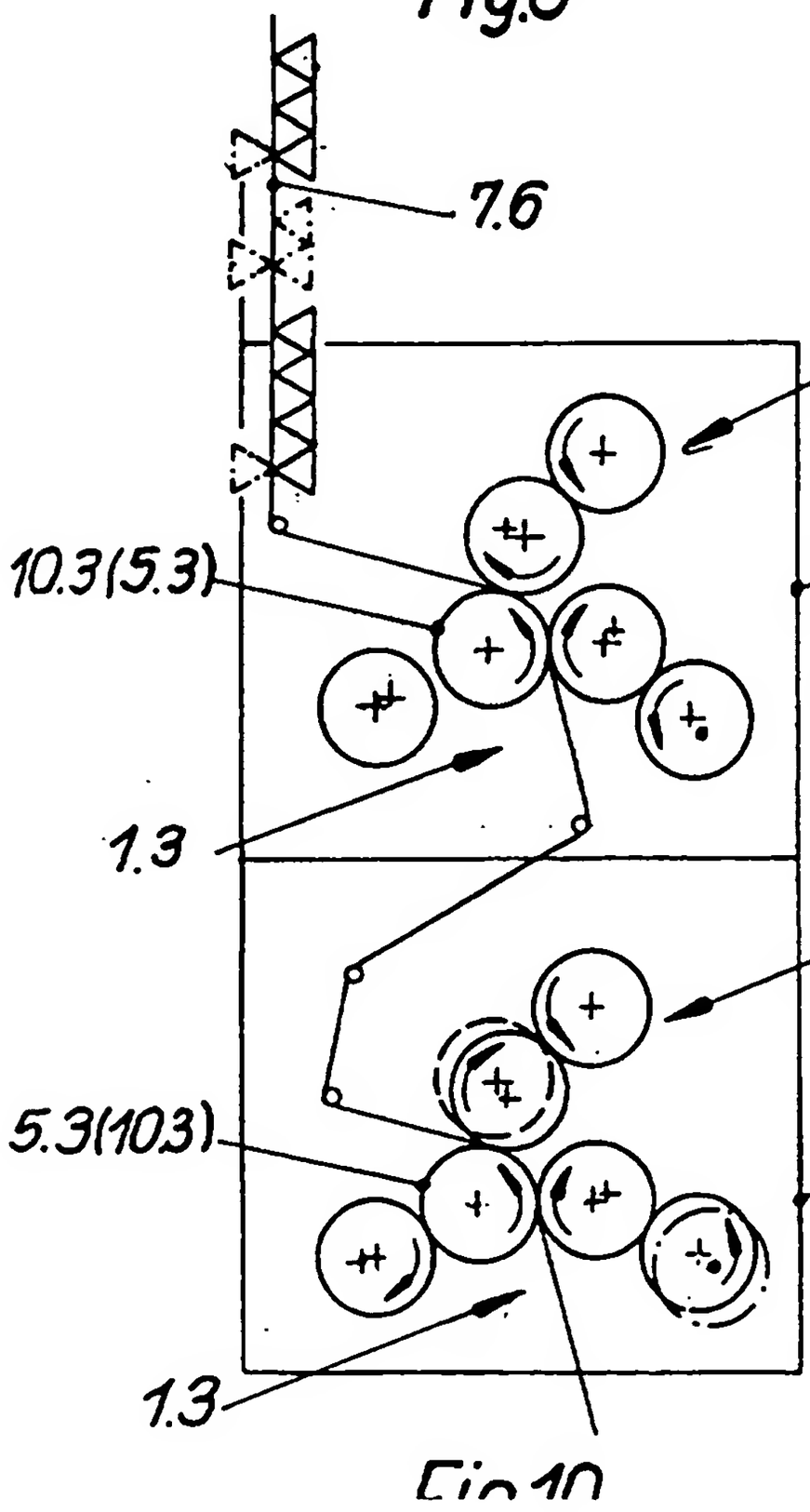


Fig.10

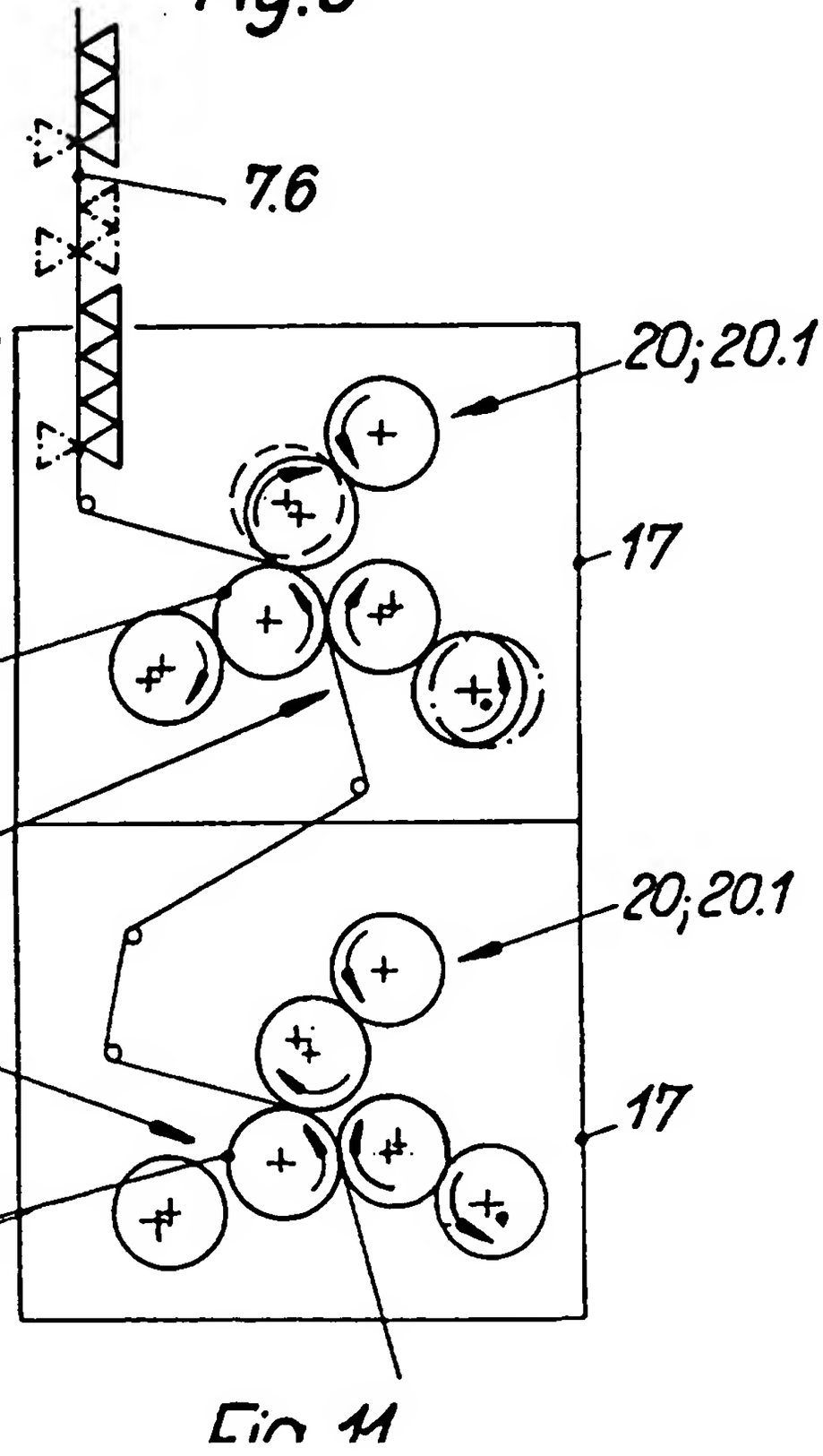


Fig.11

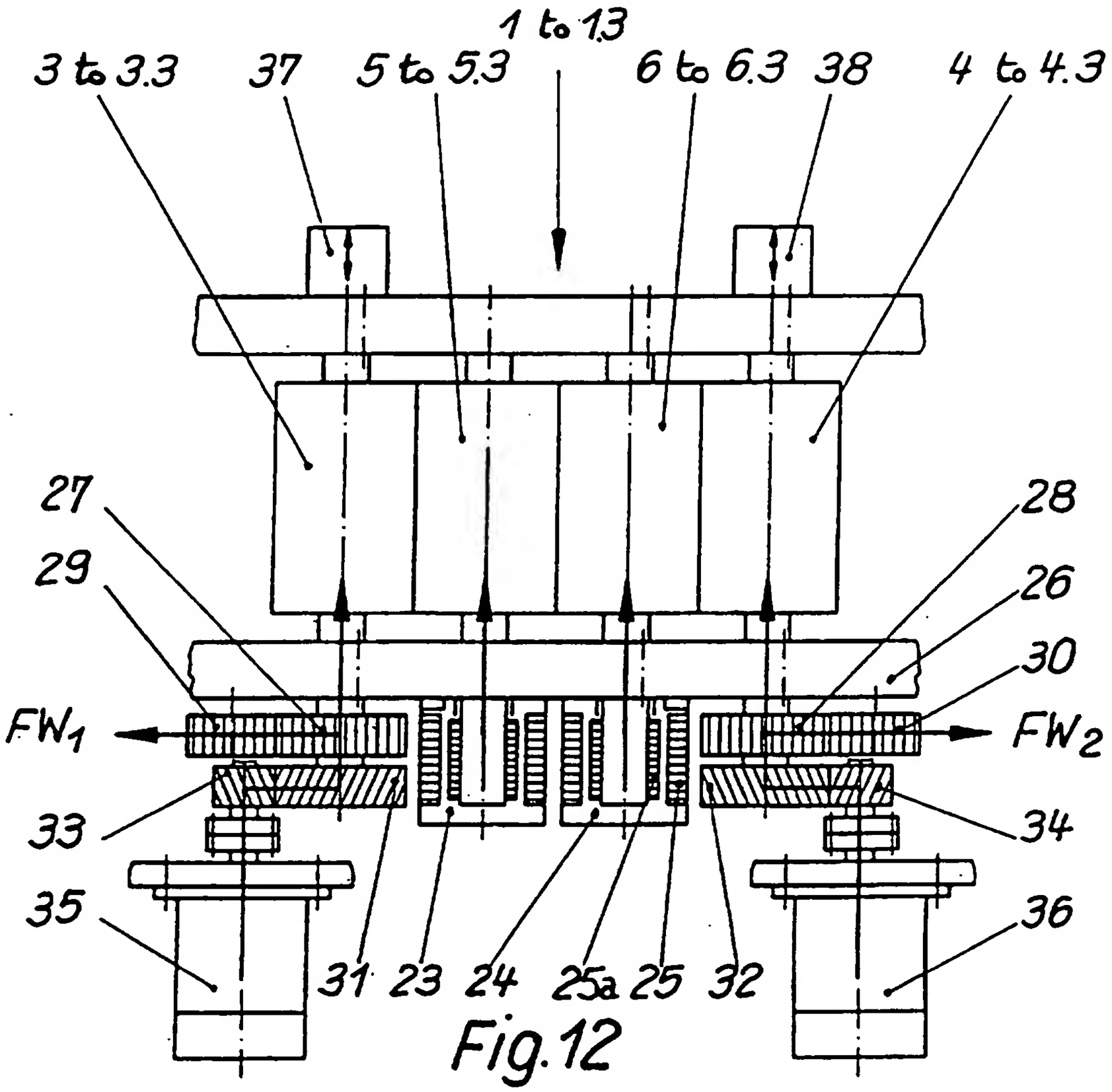

1 to 1.3
3 to 3.3
37
5 to 5.3
6 to 6.3
38
4 to 4.3
27
28
29
26
30
FW1
FW2
33
34
35
36
31
23
24
25a
25
32

Fig.12

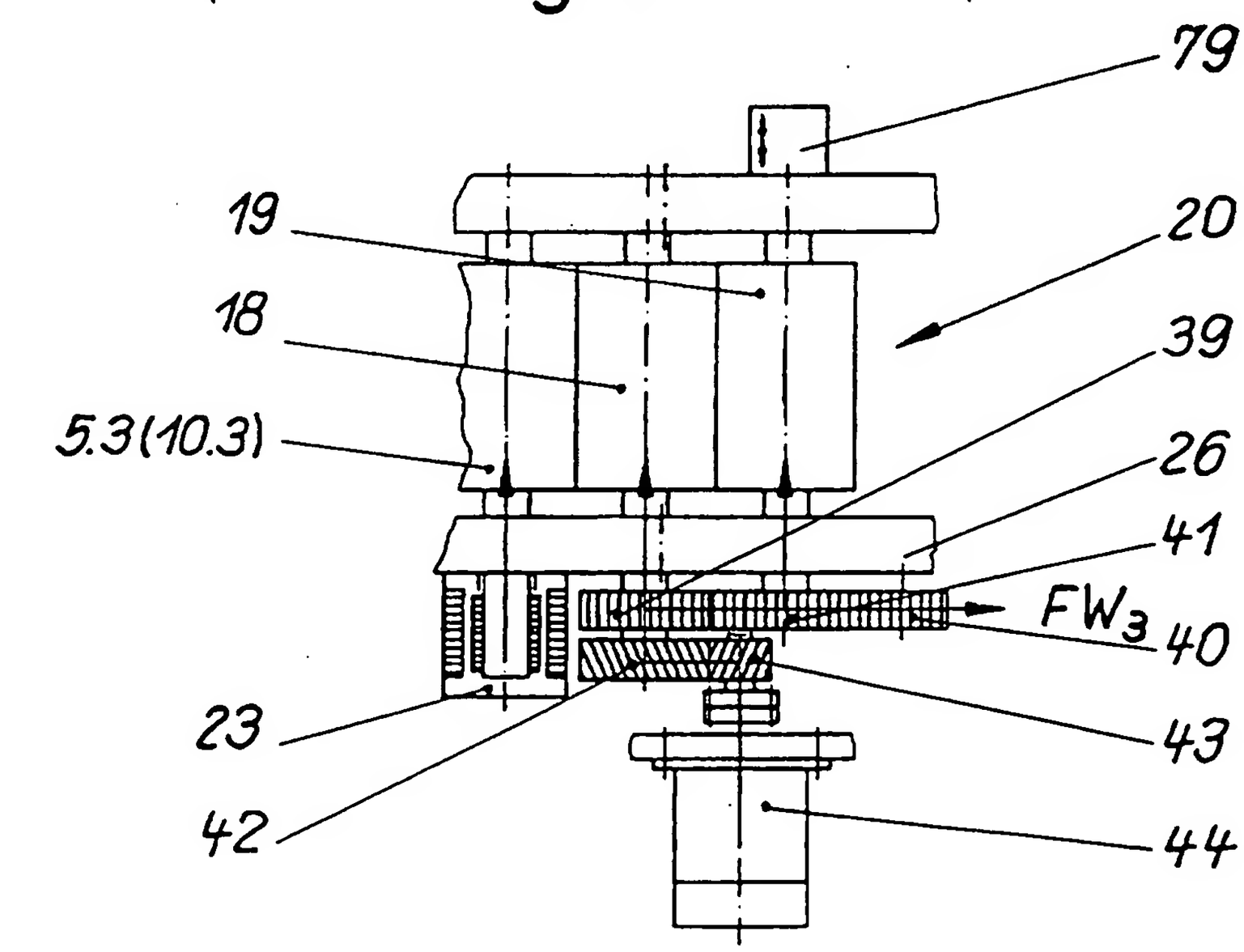
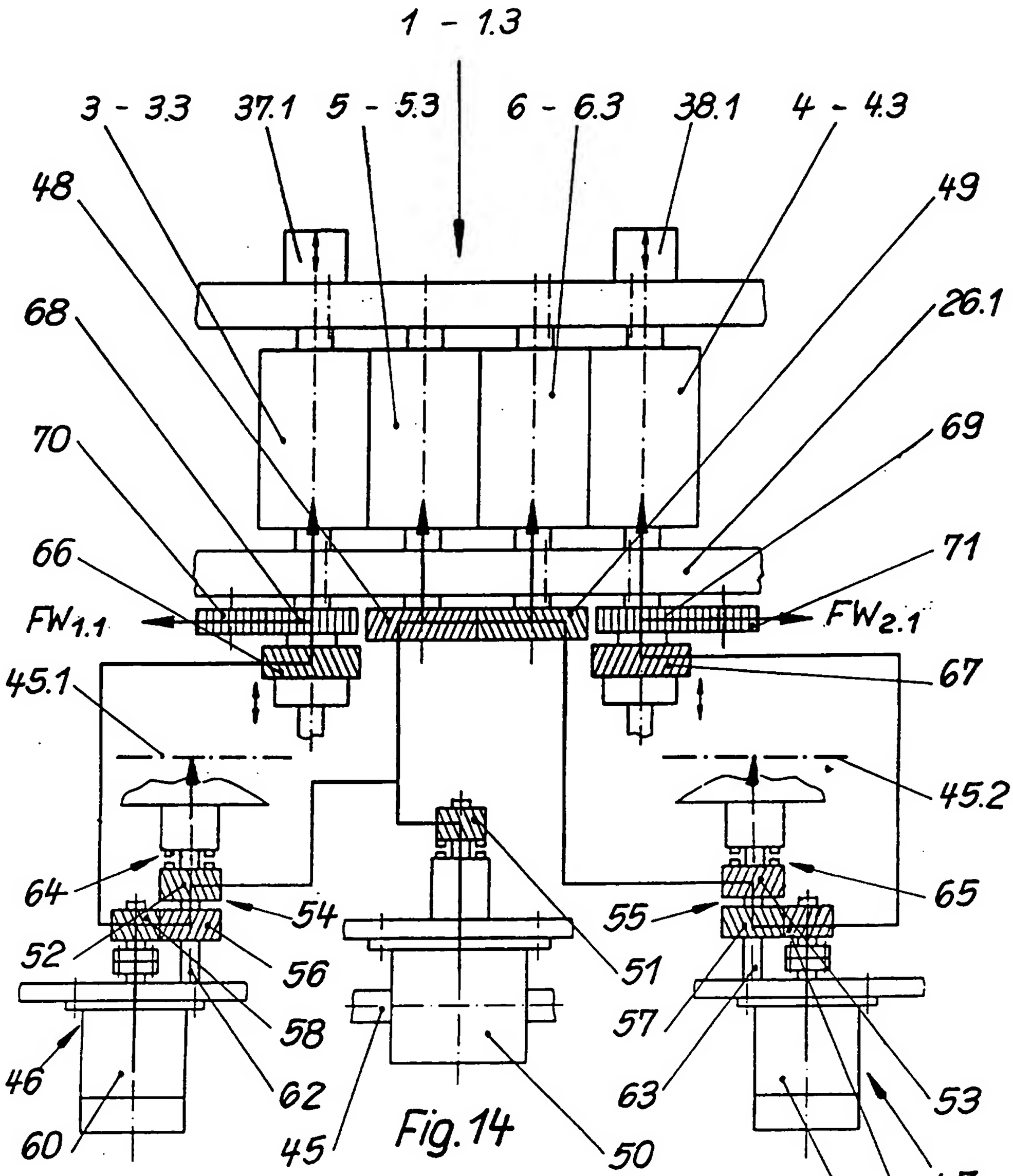

79
19
20
18
39
5.3(10.3)
26
41
FW3
40
23
43
42
44

Fig.13


1 - 1.3
3 - 3.3
37.1
5 - 5.3
6 - 6.3
38.1
4 - 4.3
48
49
68
26.1
70
69
66
71
FW1.1
FW2.1
45.1
67
45.2
64
65
54
55
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56
51
58
57
46
62
45
63
53
50
47
60
59
61

Fig. 14

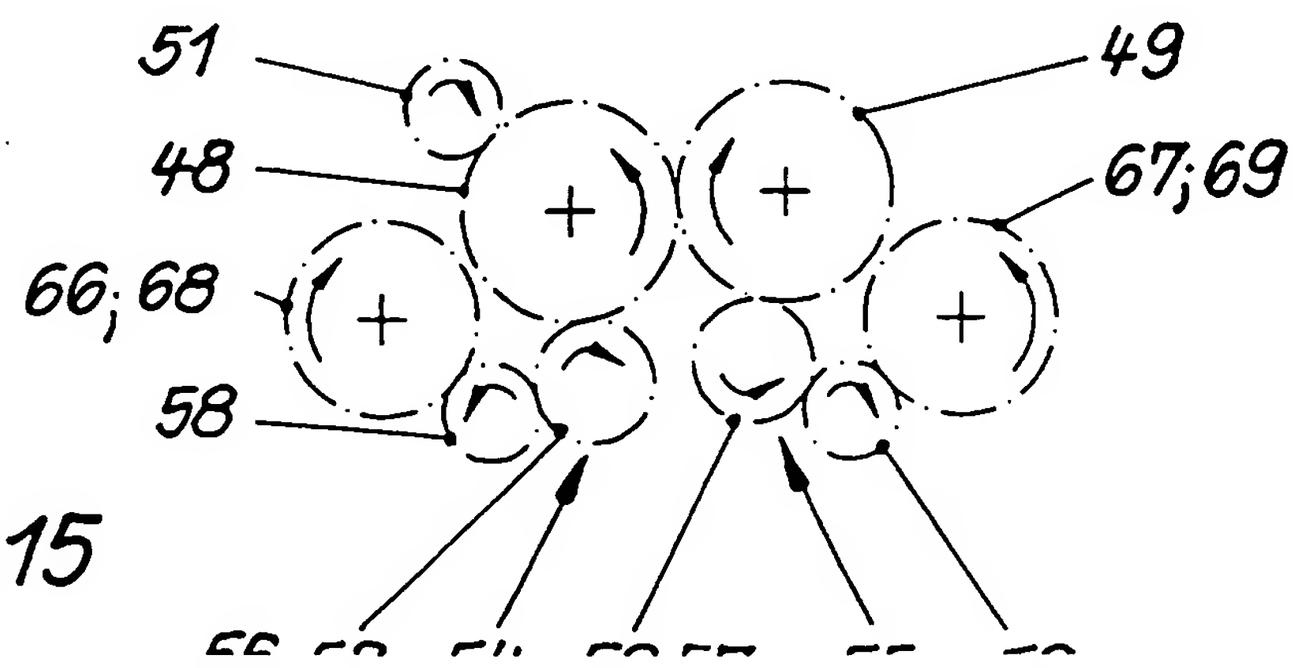

51
49
48
67;69
66;68
58

Fig. 15

Fig.16

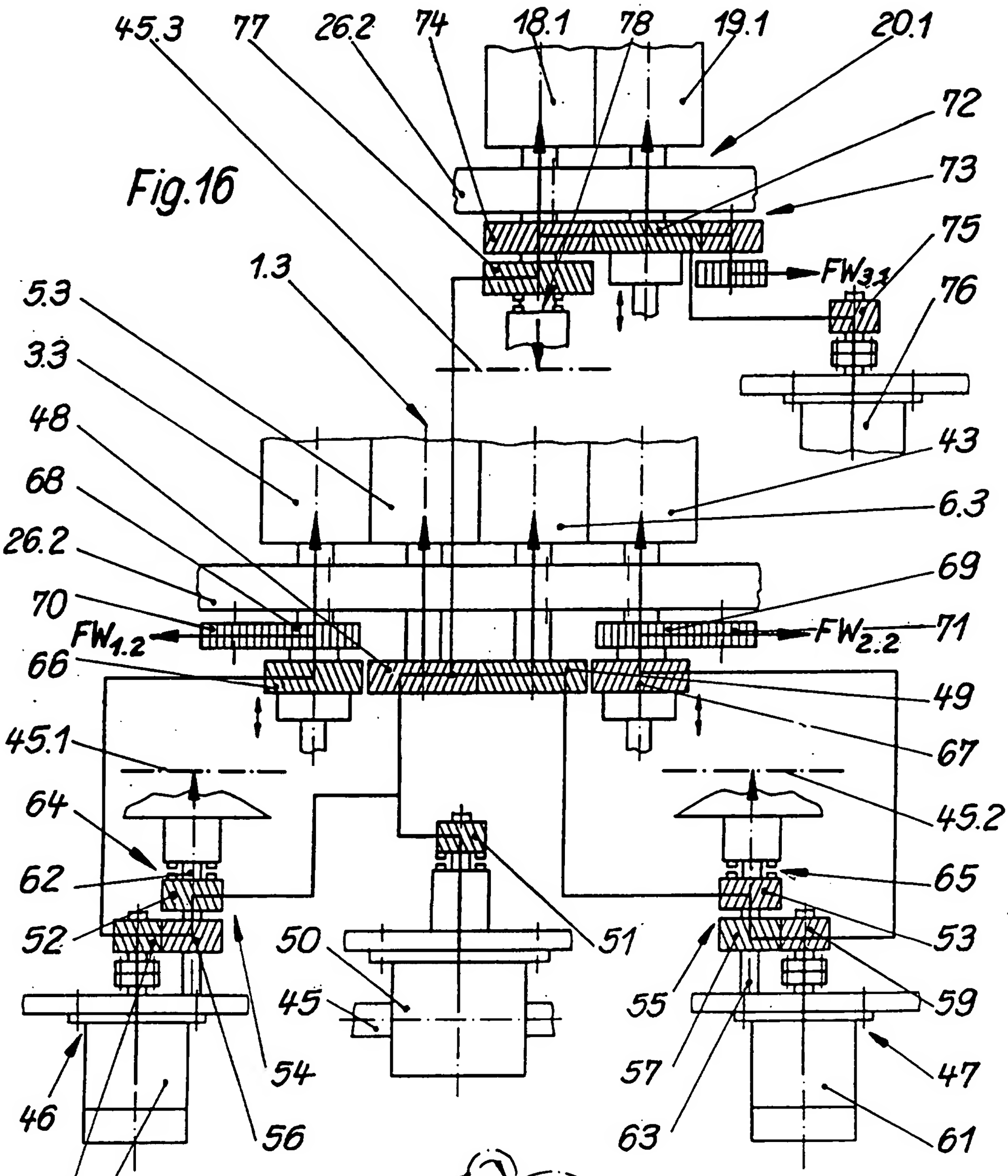
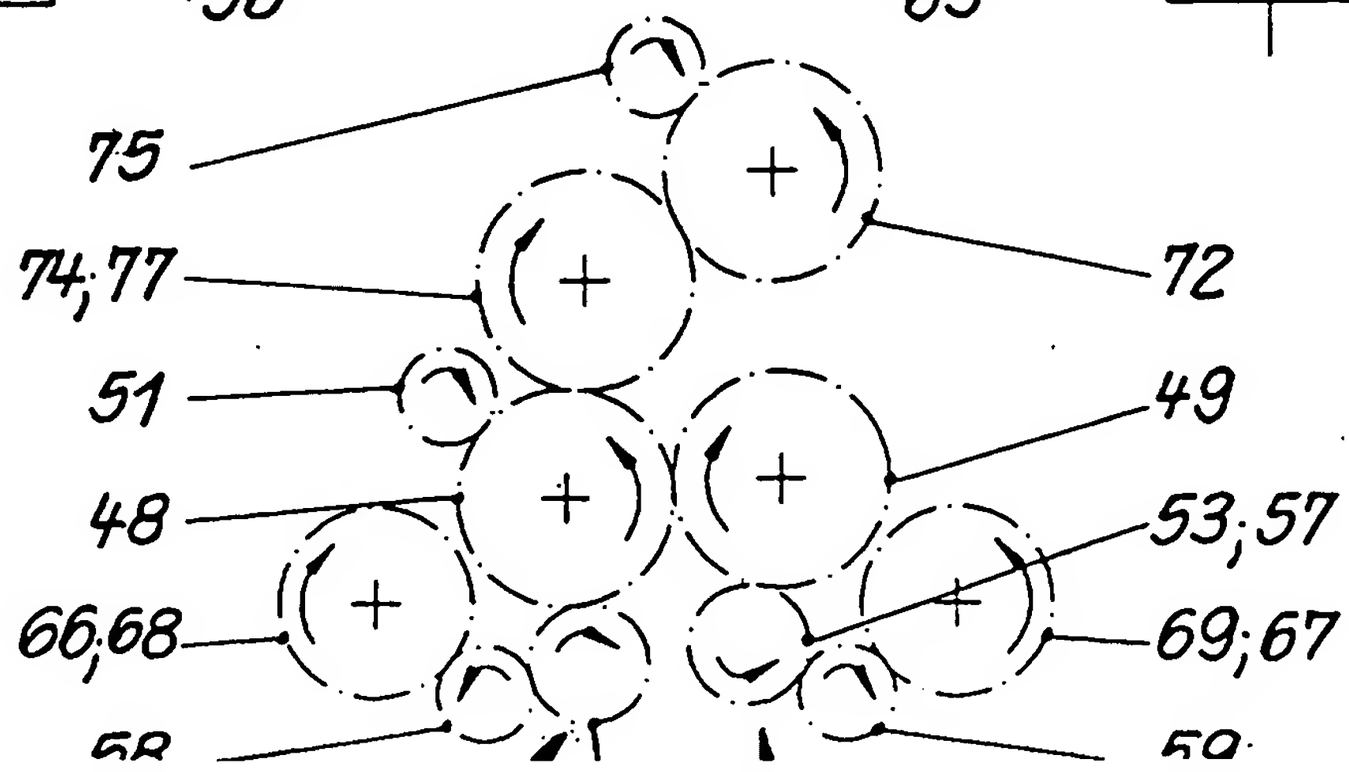

45.3
77
26.2
74
18.1
78
19.1
20.1
72
73
75
76
$FW_{3.1}$
1.3
5.3
3.3
48
68
26.2
70
$FW_{1.2}$
66
45.1
64
62
52
46
58
60
54
56
50
45
51
43
6.3
69
$FW_{2.2}$
71
49
67
45.2
65
53
59
55
57
63
47
61

Fig.17


75
74;77
51
48
66;68
72
49
53;57
69;67

Printing unit for flying plate exchange

The invention relates to a printing unit for flying plate exchange of the kind having two transfer cylinders applying ink to a printing material web fed between them and two forme cylinders each co-operating with one of the transfer cylinders and fitted with exchangeable plates.

DE 35 10 822 C1 discloses such a printing unit provided with two transfer cylinders which apply ink to a printing material web which is guided between them, and two forme cylinders each co-operating respectively with one of the transfer cylinders and equipped with exchangeable plates. The cylinders can be driven synchronously in a spaced-apart position in the printing-off configuration. For flying plate exchange the transfer cylinders can be applied alternately against an additional impression cylinder so as to enable a one-sided ink application to the printing material web in recto or verso print respectively.

A disadvantage of this system is the fact that the impression cylinder is not needed when a two-sided ink coverage of the printing material web is carried out by the transfer cylinders applied against each other. Apart from the concomitant expense, it requires a special configuration of printing unit which is different from that of a four-cylinder printing unit. In addition, when changing over the printing unit during flying plate exchange the respective printing point moves and so additional register compensation measures are necessary when further processing the printing material web within the printing machine.

Moreover, similar prior art can also be found in DE 3614029 C1, DE 3825145 C2, EP 0242649 B1 and EP 0276745 A2; the system in the last document even

uses two additional impression cylinders onto each of which one transfer cylinder can be pivoted.

EP 0644048 A2 shows a pair or couple consisting of a transfer cylinder and a forme cylinder respectively forming a cylinder group, the two cylinders being mechanically coupled together and jointly driven by an individual drive motor. Two pairs of cylinders respectively work together as a printing point, and between them passes the printing material web which can be coated with ink on one or both sides.

A flying plate exchange can be carried out with two printing points arranged one behind the other in the direction of travel of the printing material web, the plate exchange being effected in the stationary cylinder group with its transfer cylinders pivoted away from the printing material web. Hence with this type of operation only two of the four groups of cylinders are effectively used for the printing process.

An additional disadvantage is that, in view of the change of printing point, when plate exchange is necessary on only one side, in the case of two-sided ink application to the printing material web the plates on the opposite side must also be exchanged.

It is thus desirable to produce a printing unit for flying plate exchange which ensures the preservation of the printing points on the printing material web during flying plate exchange, the greatest possible uniformity of configuration of printing units designed either without or with flying plate exchange and, in the case of the latter, an economical use in both types of operation.

According to the invention there is provided a printing unit for flying plate exchange of a web offset rotary printing machine, which is provided with two transfer cylinders applying ink to a printing material web fed between them and two forme cylinders each co-

operating with one of the transfer cylinders and fitted with exchangeable plates and whose cylinders, at a distance from each other in the printing-off configuration, are synchronously drivable, in which at least one forme cylinder can be moved away from the associated transfer cylinder into a position enabling changing of the plates and is drivable and stoppable separately from the drive of the other printing unit cylinders, and the transfer cylinder, acting in the plate exchange position of the forme cylinder as an impression cylinder for the other transfer cylinder is adapted to be synchronously driven with the latter and with the forme cylinder co-operating with it.

Using the "spare" transfer cylinder as an impression cylinder ensures retention of the printing points with and without, and indeed during, flying plate exchange, thus reducing the number of plates to be exchanged. All the cylinders of the printing unit are used in both types of operation. Printing units designed for no plate exchange and for flying plate exchange can to a large extent have the same configuration, since the space requirement for the additional pivoting of the forme cylinder is small. In addition, the pivoting function can be achieved with relatively little technical expenditure in connection with the drive means for the cylinders provided therefor.

Preferably at least one of the transfer cylinders is pivotable away from the other so as to allow a non-printing configuration in which the web passes through without contact.

Fig. 1 shows a four-cylinder printing unit in accordance with the invention as a U-printing element;

Fig. 2 shows two four-cylinder printing units in accordance with the invention in mirror-image arrangement as an H-printing element;

Fig. 3 shows a four-cylinder printing unit in accordance with the invention with an additional insert print unit, forming a Y-printing element;

Fig. 4 shows a main and an alternative arrangement of two printing units in accordance with Fig. 1 in the direction of travel of a printing material web;

Fig. 5 shows an arrangement in accordance with Fig. 4 with a flying plate exchange on the upper left-hand forme cylinder;

Fig. 6 shows an arrangement of two printing elements in accordance with Fig. 2 with flying plate exchange on the upper printing element in recto or additionally verso printing with the production of a coating on the printing material web in two colours;

Fig. 7 shows an arrangement in accordance with Fig. 6 with flying plate exchange on the lower printing element;

Fig. 8 shows an arrangement of two printing elements in accordance with Fig. 3 with thrown-off insert print unit and flying plate exchange on the upper printing element in recto or additionally verso printing with the production of a coating on the web in one colour;

Fig. 9 shows an arrangement in accordance with Fig. 8 with flying plate exchange on the lower printing element;

Fig. 10 shows an arrangement in accordance with Fig. 8 with insert print unit engaged, and its alternative application for the flying plate exchange, shown with dot-dashed lines, for the production of a coating on the printing material web in recto printing in one colour and in verso printing in up to two colours;

Fig. 11 shows an arrangement in accordance with Fig. 10 with a flying plate exchange on the lower printing element;

Fig. 12 shows a drive variant for a four-cylinder printing unit in accordance with Figs. 1, 2 and 3 with an individual drive for each cylinder;

Fig. 13 shows a drive variant extended by one insert print unit in accordance with Fig. 12 for a Y-printing element according to Fig. 3;

Fig. 14 shows a drive variant for a four-cylinder printing unit in accordance with Figs. 1, 2 and 3 with two individual drives synchronised by means of a longitudinal shaft;

Fig. 15 shows a spur gear drive of the drive variant according to Fig. 14;

Fig. 16 shows a drive variant extended by one insert print unit in accordance with Fig. 14 for a Y-printing element according to Fig. 3;

Fig. 17 shows a spur gear drive of the drive variant according to Fig. 16.

In Figs. 1 to 11 the dot-dashed triangles shown on the printing material web symbolise the inks to be printed without interruption during continued running of the press with flying plate exchange, whilst the triangles shown by complete lines symbolise the inks whose printing is interrupted by the plate exchange. The dot-dashed triangles shown in brackets refer to a possible realisation in co-operation with a further similar printing unit.

Fig. 1 shows a four-cylinder printing unit 1 for offset printing as a U-printing element 2. The printing unit 1 has two outer forme cylinders 3; 4, whose exchangeable plates (not shown) are dampened by a dampening unit and inked by an inking unit in a known way. Two transfer cylinders 5; 6, each in contact with a forme cylinder 3; 4, coat both sides of a printing material web 7 fed through between them with ink.

Of the two forme cylinders 3; 4, in order to

enable a flying plate exchange, at least one forme cylinder 3 is pivotable away from the associated transfer cylinder 5 out of the printing-on configuration 8 into a plate exchange position 9, dashed outline, enabling in the stopped condition an exchange of the plates. The transfer cylinder 5, while continuing to be driven synchronously to the other printing cylinder 6 and serving as an impression cylinder 10 for the other transfer cylinder 6, ensures an uninterrupted one-sided ink application to the printing material web 7.

As shown in Fig. 1 in dot-dashed lines, the second forme cylinder 4 can also be fitted in the way described to be pivotable out of a printing-on configuration 11 into a plate exchange position 12 for the flying plate exchange and the associated transfer cylinder 6 can serve as an impression cylinder 13 for the other transfer cylinder 5. The pivoting away of the two forme cylinders 3; 4 during printing is carried out alternately.

Of the two transfer cylinders 5; 6, at least one transfer cylinder 6 can be thrown off in such a way that the printing material web 7, which in the printing-on configuration 14 shown by the complete line passes slightly round the transfer cylinder 6, in the printing-off configuration 15 shown by the dashed line passes between the two transfer cylinders 5; 6 without contact.

In the printing-off configuration of all printing unit cylinders these are free from contact with each other and drivable in synchrony with the web travel. For this purpose the pivotable forme cylinders 3; 4, at least in the case of a non-pivotable transfer cylinder 5, are pivotable into an intermediate position releasing them slightly from contact with the latter.

Fig. 2 shows an H-printing element 16, which

consists of two successive four-cylinder printing units 1.1; 1.2 constructed analogously to Fig. 1 and arranged in mirror-image to each other about a plane perpendicular to the web travel.

Depending on whether only the two left-hand forme cylinders 3.1; 3.2 or also the right-hand forme cylinders 4.1; 4.2 are pivotable away from the respective transfer cylinders 5.1; 5.2 and 6.1; 6.2, with a flying plate exchange the printing material web 7.1 can be coated during recto printing or also verso printing with one colour each without interruption.

Fig. 3 shows a Y-printing element 17, which consists of a four-cylinder printing unit 1.3 extended by an insert print unit 20 comprising a transfer cylinder 18 and a forme cylinder 19. Here the pivotable transfer cylinder 18 of the insert print unit 20 in the printing-on configuration 21 is in contact with both its forme cylinder 19 and with the non-pivotable transfer cylinder 5.3 of the four-cylinder printing unit 1.3. In this way the insert print unit 20 can be used for a conventional double or, in connection with a pivotable right-hand forme cylinder 4.3 of the four-cylinder printing unit 1.3 enabling the flying plate exchange, for an uninterrupted single verso print on the printing material web 7.2. The plate exchange on the forme cylinder 19 is always carried out when the associated transfer cylinder 18 is stopped in its printing-off position 22.

Figs. 4 and 5 show two U-printing elements 2 arranged one behind the other in the direction of travel of the web according to Fig. 1, and having the same orientation rather than in mirror-image, in which during flying plate exchange the basic variant with pivotable forme cylinders 3 arranged only on the left enables an uninterrupted single ink deposition on the printing material web 7.3 in recto print and the

variant shown by dot-dashed lines with the right-hand forme cylinders 4 also pivotable enables ink deposition in the same manner with verso printing.

Fig. 4 shows flying plate exchange in recto printing on the lower left-hand forme cylinder, as well as the dot-dashed representation of an additional flying plate exchange in verso printing with the production of a coating of the printing material web in one colour. In Fig. 4 the plate exchange is being carried out on the pivoted out, stopped, left-hand forme cylinder 3 of the lower U-printing element 2 and in the variant shown by a dashed line additionally on the right-hand forme cylinder 4 of the upper U-printing element 2, whilst in Fig. 5 it is being carried out the other way around, on the left-hand forme cylinder 3 of the upper U-printing element 2 and, as the case may be, on the right-hand forme cylinder 4 of the lower U-printing element 2.

Figs. 6 and 7 show two H-printing elements 16 in accordance with Fig. 2 arranged one behind the other in the direction of travel of the web. During flying plate exchange the basic variant with only the left-hand forme cylinders 3.1; 3.2 pivotable enables an uninterrupted two-colour deposition on the printing material web in recto print and the variant shown by dashed lines with additional pivotable forme cylinders 4.1; 4.2 arranged on the right also enables ink deposition in the same way in verso print.

In Fig. 6 the plate exchange is carried out on the pivoted away, stopped, left-hand forme cylinders 3.1; 3.2 of the upper H-printing element and in the variant shown by a dot-dashed line additionally on the right-hand forme cylinders 4.1; 4.2 of the lower H-printing element, whilst in Fig. 7 it is carried out the other way round, on the left-hand forme cylinders 3.1; 3.2 of the lower H-printing element 16 or additionally on the

right-hand forme cylinders 4.1; 4.2 of the upper H-printing element 16.

Figs. 8 to 11 show two Y-printing elements 17 arranged one behind the other in the direction of travel of the web in accordance with Fig. 3, in the same orientation.

In Figs. 8 and 9, with an insert print unit 20 out of action, ink is deposited on the printing material web in the same way as in Figs. 4 and 5, with the same opportunities for flying plate exchange.

Figs. 10 and 11 show the additional application of the insert print unit 20 and its use for flying plate exchange for ensuring an uninterrupted two-colour verso print on the printing material web 7.6.

For all four-cylinder printing units 1; 1.1; 1.2; 1.3 it is generally the case that all cylinders, whether in the printing-on or printing-off configuration, can be driven synchronously to the web travel. Moreover the forme cylinders 3; 3.1; 3.2; 3.3 and 4; 4.1; 4.2; 4.3 respectively, that are used for flying plate exchange, can, in their pivoted-off state, be stopped separately from the other cylinders during operation and then once again brought up to their speed.

The insert print unit 20 of the printing unit 17 is, both in the printing-on and printing-off configuration of the cylinders, drivable synchronously to the web travel and thus to the cylinders of the four-cylinder printing unit, and can be stopped separately from the latter and then once again brought up to its speed.

The printing unit cylinders can be motor-driven individually or in groups, as well as in combination with a couplable and uncouplable mechanical longitudinal shaft drive for the printing units, the pivotable forme cylinders 3; 3.1; 3.2; 3.3 and 4; 4.1;

4.2; 4.3 respectively however always being separately individually drivable and, if necessary, when separate drives are not present for all cylinders, couplable at a synchronous speed to the remaining cylinders of the relevant four-cylinder printing unit 1; 1.1; 1.2; 1.3.

Fig. 12 shows the drive for a four-cylinder printing unit 1; 1.1; 1.2; 1.3, whose cylinders are motor-driven individually. Here the two transfer cylinders 5 to 5.3; 6 to 6.3 are each driven individually by a coaxially arranged motor 23; 24, the stator 25 of the motor 24 of the transfer cylinder 6 to 6.3, which is pivotable for the printing-off configuration, is in a manner not shown either articulated on the frame 26 by means of a torque support or is adjustable by means of an adjustment mechanism of the eccentric bearing bushing adjustment of the transfer cylinder 6 to 6.3 fixedly provided coaxially with the rotor 25a of the motor 24.

The adjustable forme cylinders 3 to 3.3 or 4 to 4.3 are each connected in one drive plane by means of a straight-toothed cylinder spur gear 27; 28 and further spur gears 29; 30 to an inking and dampening unit FW_1 or FW_2 and are provided in a second drive plane, further from the cylinders, with a further cylinder spur gear 31; 32, here helical, which is in engagement with a drive pinion 33; 34 of a frame-fixed motor 35; 36. The pitch diameters of the two cylinder spur gears 27; 31 and 28; 32 respectively are the same size, so as to enable a rotational movement of the forme cylinder 3 to 3.3 or 4 to 4.3 around the drive pinion 33; 34.

The forme cylinders 3 to 3.3 or 4 to 4.3 are provided on the side opposite the drive side with a lateral register control gear 37; 38. The circumferential register adjustment of the forme cylinders is carried out in a regulated manner by means of the respective motor 35; 36.

Fig. 13 shows a drive of the four-cylinder printing unit 1.3 according to Fig. 12 extended by an additional insert print unit 20 of the Y-printing element 17. Here the transfer cylinder 18 of the insert print unit 20 in one drive plane engages via a straight-toothed cylinder spur gear 39 into a cylinder spur gear 41 of the associated forme cylinder 19, which is in connection with an inking and dampening unit FW_3 via further spur gears 40. The transfer cylinder 18 has in a second drive plane a second cylinder spur gear 42, which is in engagement with a drive pinion 43 of a frame-fixed motor 44. The pitch diameters of the two cylinder spur gears 39; 42 are once again the same size, so as to enable a rotational movement of the transfer cylinder 18 around the drive pinion 43.

Fig. 14 shows the drive for a four-cylinder printing unit 1 to 1.3 in which instead of separate drives there are only two individual drives 46; 47, mechanically synchronised by means of a longitudinal shaft 45; 45.1; 45.2.

The two transfer cylinders 5 to 5.3; 6 to 6.3 during operation are continually in engagement with each other each via respective helical cylinder spur gears 48; 49, while ensuring that radial displacement of the right-hand transfer cylinder 6 to 6.3 to its printing-off position from the left-hand transfer cylinder 5 to 5.3 is possible. Firstly a helically toothed pinion 51 couplable true-to-register with the longitudinal shaft 45 via a drive unit 50 engages in the left-hand cylinder spur gear 48 and similarly one spur gear 52; 53 of a double spur gear 54; 55 engages into each of the two cylinder spur gears 48; 49, while the second spur gear 56; 57 is in engagement with a helical drive pinion 58; 59 of a frame-fixed motor 60; 61. The spur gear 52; 53, otherwise arranged loosely on a shaft 62; 63 of the double spur gear 54; 55, is

fixable true-to-register with respect to both the shaft 62; 63 and the longitudinal shaft 45.1; 45.2 by means of a coupling 64; 65, for instance of the dog-clutch type.

The drive pinion 58; 59 is likewise in engagement with a helically toothed cylinder spur gear 66; 67 of the forme cylinder 3 to 3.3; 4 to 4.3, which is axially displaceable for circumferential register adjustment of the forme cylinder 3 to 3.3; 4 to 4.3 when coupled to the longitudinal shaft 45.1; 45.2.

In a second drive plane a straight-toothed second cylinder spur gear 68; 69 for the forme cylinder 3 to 3.3; 4 to 4.3, which is pivotable around the drive pinion 58; 59, and is of the same pitch diameter as the corresponding helical gear 66, 67, is in drive engagement via spur gears 70; 71 with an inking and dampening unit $FW_{1.1}$; $FW_{2.2}$.

Fig. 15 shows a side view of how the spur gears interengage in the drive variant according to Fig. 14.

Fig. 16 shows a drive variant of the four-cylinder printing unit 1.3 according to Fig. 14 extended by an additional insert print unit 20.1 as a Y-printing element 17 according to Fig. 3. Here a helically toothed cylinder spur gear 72 of the forme cylinder 19.1 of the insert print unit 20.1 on the one hand is in drive connection, via a double spur gear 73 enabling the change from a helical toothing to a straight toothing, with the inking and dampening unit $FW_{3.1}$ and on the other hand is in direct drive connection with a cylinder spur gear 74 of the associated transfer cylinder 18.1 with a radial play as required for its printing-off configuration and with a drive pinion 75 of a frame-fixed motor 76.

The transfer cylinder 18.1 has in a further drive plane a second cylinder spur gear 77, which is in engagement with the cylinder spur gear 48 of the left-

engagement with the cylinder spur gear 48 of the left-hand transfer cylinder 5.3 of the four-cylinder printing unit 1.3 and, otherwise located loosely, can be fixed true-to-register by means of a coupling 78 with respect to both the longitudinal shaft 45.3 and the transfer cylinder 18.1.

Also the forme cylinder 19; 19.1 of the insert print unit 20; 20.1 is provided analogously to the forme cylinders 3 to 3.3; 4 to 4.3 of the four-cylinder printing unit 1 to 1.3 on the side opposite the drive side with a lateral register control gear 79 (Fig. 13) and is adjustable for the circumferential register in the drive variant according to Fig. 16 by means of an axial displacement of its cylinder spur gear 72 during operation.

Fig. 17 shows a side view of the engagement condition of the gears of the drive variant according to Fig. 16.

It will be understood that while various cylinders are described above as pivotable they could be displaceable in other ways between their on and off configurations, such as by sliding.

List of the reference numerals used:

1; 1.1; 1.2; 1.3	Four-cylinder printing unit
2	U-printing element
3; 3.1; 3.2; 3.3	Forme cylinder
4; 4.1; 4.2; 4.3	Forme cylinder
5; 5.1; 5.2; 5.3	Transfer cylinder
6; 6.1; 6.2; 6.3	Transfer cylinder
7; 7.1; 7.2; 7.3; 7.4; 7.5; 7.6	Printing material web
8	Printing-on configuration
9	Plate exchange position
10; 10.1; 10.2; 10.3	Impression cylinder
11	Printing-on position
12	Plate exchange position
13; 13.1; 13.2	Impression cylinder
14	Printing-on configuration
15	Printing-off configuration
16	H-printing element
17	Y-printing element
18; 18.1	Transfer cylinder
19; 19.1	Forme cylinder
20; 20.1	Insert print unit
21	Printing-on configuration
22	Printing-off configuration
23	Motor
24	Motor
25	Stator
26; 26.1; 26.2	Frame
27	Cylinder spur gear
28	Cylinder spur gear
29	Spur gear
30	Spur gear
31	Cylinder spur gear
32	Cylinder spur gear

33	Drive pinion
34	Drive pinion
35	Motor
36	Motor
37; 37.1	Lateral register control gear
38; 38.1	Lateral register control gear
39	Cylinder spur gear
40	Spur gear
41	Cylinder spur gear
42	Cylinder spur gear
43	Drive pinion
44	Motor
45; 45.1; 45.2; 45.3	Longitudinal shaft
46	Separate drive
47	Separate drive
48	Cylinder spur gear
49	Cylinder spur gear
50	Gear unit
51	Pinion
52	Spur gear
53	Spur gear
54	Double spur gear
55	Double spur gear
56	Spur gear
57	Spur gear
58	Drive pinion
59	Drive pinion
60	Motor
61	Motor
62	Shaft
63	Shaft
64	Coupling
65	Coupling
66	Cylinder spur gear
67	Cylinder spur gear
68	Cylinder spur gear

69	Cylinder spur gear
70	Spur gear
71	Spur gear
72	Cylinder spur gear
73	Double spur gear
74	Cylinder spur gear
75	Drive pinion
76	Motor
77	Cylinder spur gear
78	Coupling
79	Lateral register control gear
FW_1; $FW_{1.1}$; $FW_{1.2}$	Inking and dampening unit
FW_2; $FW_{2.1}$; $FW_{2.2}$	Inking and dampening unit
FW_3; $FW_{3.1}$	Inking and dampening unit

▽ Ink deposition on the printing material web without flying plate exchange

▽ Ink deposition on the printing material web with flying plate exchange

Claims

1. A printing unit for flying plate exchange of a web offset rotary printing machine, which is provided with two transfer cylinders (5,6) applying ink to a printing material web fed between them and two forme cylinders (3,4) each co-operating with one of the transfer cylinders and fitted with exchangeable plates and whose cylinders, at a distance from each other in the printing-off configuration, are synchronously drivable, in which at least one forme cylinder (3 to 3.3) can be moved away from the associated transfer cylinder (5 to 5.3) into a position enabling changing of the plates and is drivable and stoppable separately from the drive of the other printing unit cylinders, and the transfer cylinder (5 to 5.3), acting in the plate exchange position (9) of the forme cylinder (3 to 3.1) as an impression cylinder (10 to 10.3) for the other transfer cylinder (6 to 6.3), is adapted to be synchronously driven with the latter and with the forme cylinder (4 to 4.3) co-operating with it.

2. A printing unit according to claim 1, in which both forme cylinders (3 to 3.3; 4 to 4.4) are alternately moveable away from the respective associated transfer cylinder (5 to 5.3; 6 to 6.3) into a plate exchange position (9; 12), during which the transfer cylinder (5 to 5.3 or 6 to 6.3) associated with the moved forme cylinder (3 to 3.1 or 4 to 4.1) co-operates as an impression cylinder (10 to 10.3 or 13 to 13.3) with the other transfer cylinder (6 to 6.3 or 5 to 5.3).

3. A printing unit according to claim 1 or 2 and including a further transfer cylinder (18; 18.1) co-operating with a forme cylinder (19; 19.1), the further transfer cylinder being capable of application to one of the aforesaid transfer cylinders (5.3),

preferably not one adjustable into a printing-off configuration, thus forming an additional insert print unit (20; 20.1), wherein the thrown-off insert print unit (20; 20.1) can be driven and stopped both synchronously to and separately from the four-cylinder printing unit (1.3).

4. A printing unit according to any preceding claim, in which several, preferably two or four, four-cylinder printing units (1 to 1.3) are arranged one behind the other in the direction of travel of the printing material web (7), each being provided with one or two movable forme cylinders (3 to 3.1 or 4 to 4.1) in dependence on their configuration, as well as with an additional insert print unit (20; 20.1), enabling the performance of a one- or two-sided continuous ink deposition on the printing material web (7) with at least one or several, preferably up to two colours, with a flying plate exchange.

5. A printing unit according to claim 2 and 4, in which the four-cylinder printing units (1) are configured as U-printing elements (2) or are configured (1.1; 1.2) in double, mirror-image arrangement as H-printing elements (16).

6. A printing unit according to claim 5, in which the two transfer cylinders (5 to 5.3; 6 to 6.3) of a four-cylinder printing unit (1 to 1.3) are drivable directly each by means of a coaxially arranged motor (23; 24) while ensuring a radial adjustability of at least one transfer cylinder (6 to 6.3) to its printing-on and -off position with respect to the other transfer cylinder (5 to 5.3) and that the forme cylinders (3 to 3.3) are each connected via a straight-toothed cylinder spur gear (27; 28) as well as further spur gears (29; 30) to an inking and dampening unit (FW_1; FW_2) and in a second drive plane are in engagement with a drive pinion (33; 34) of a frame-

– fixed motor (35; 36) by means of a second cylinder spur gear (31; 32), the pitch diameters of the two spur gears (27; 31 or 28; 32) being the same size, so as to enable a rotational movement of the respective forme cylinder (3 to 3.3; 4 to 4.3) around the drive pinion (33; 34) and thus the pivoting of the forme cylinder (3 to 3.3; 4 to 4.3) away from the associated transfer cylinder (5 to 5.3; 6 to 6.3).

7. A printing unit according to claim 5, in which the two transfer cylinders (5 to 5.3; 6 to 6.3) of a four-cylinder printing unit (1 to 1.3) are permanently in engagement with each other by means of cylinder spur gears (48; 49) ensuring a radial adjustability of at least one transfer cylinder (6 to 6.3) to its printing-on and -off configuration with respect to the other transfer cylinder (5 to 5.3), a cylinder spur gear (48) is couplable in register to a longitudinal shaft (45) serving for the drive synchronisation and additionally both cylinder spur gears (48; 49) are each in connection with a spur gear (52; 53), fixable true-to-register with respect to the longitudinal shaft (45. 1; 45.2) as well as to an insert print unit (46; 47) for the associated forme cylinder (3 to 3.1; 4 to 4.1) by means of a coupling (64; 65) and otherwise positioned loosely on a shaft (62; 63) of a double spur gear (54; 55), the second spur gear (56; 57) being fixed on the shaft (62; 63) and engaging into a drive pinion (58; 59) of a frame-fixed motor (60; 61), the drive pinion (58; 59) likewise being in engagement with a helically toothed cylinder spur gear (66; 67) of the associated forme cylinder (3 to 3.1; 4 to 4.3), which is in drive connection in a second drive plane with a straight-toothed cylinder spur gear (68; 69) of the same pitch diameter with an inking and dampening unit ($FW_{1.1}$; $FW_{2.1}$) and remaining in engagement with the drive

pinion (58; 59) is movable around it and thus can be moved away from the associated transfer cylinder (5 to 5.3; 6 to 6.3).

8. A printing unit according to claims 3 and 4, characterised in that the four-cylinder printing units (1.3) are each configured as Y-printing elements (17) expanded by means of an insert print unit (20; 20.1).

9. A printing unit according to claims 2 to 4, 6 and 8, in which the transfer cylinder (18) of the insert print unit (20) which in the printing-off configuration of the individually driven cylinders can be thrown onto the transfer cylinder (5.3) which is preferably not pivotable, while ensuring a radial adjustability for the printing-on and -off configuration of the transfer cylinder (18), is via a straight-toothed cylinder spur gear (39) in engagement with a cylinder spur gear (41) of the forme cylinder (19) of the insert print unit (20) and the cylinder spur gears (39; 41) are connected via further spur gears (40) to an inking and dampening unit (FW_3) and the transfer cylinder (18) of the insert print unit (20) in a second drive plane has a helically toothed second cylinder spur gear (42), that engages in a drive pinion (43) of a frame-fixed motor (44).

10. A printing unit according to claims 2 to 4, 7 and 8, in which the transfer cylinder (18.1) of the insert print unit (20.1), which in the printing-off configuration of the cylinders of a four-cylinder printing unit (1.3), mechanically drive-synchronised by means of a longitudinal shaft (45 to 45.2), can be applied to the transfer cylinder (5.3) which is preferably not pivotable, while ensuring a radial adjustability for the printing-on and -off configuration of the transfer cylinder (18.1) is via a helically toothed cylinder spur gear (74) in engagement

with a cylinder spur gear (72) of the forme cylinder (19.1) of the insert print unit (20.1), has a second cylinder spur gear (77) of the same pitch diameter in a second drive plane, that is fixable true-to-register by means of a coupling (78) with respect to both the transfer cylinder (18.1) and the longitudinal shaft (45.3) but is otherwise loose and continuously engages in the cylinder spur gear (48) of the associated transfer cylinder (5.3) of the four-cylinder printing unit (1.3) and the cylinder spur gear (72) of the forme cylinder (19.1) of the insert print unit (20.1) is both in engagement with a drive pinion (75) of a frame-fixed motor (76) and in drive connection with an inking and dampening unit ($FW_{3.1}$) via a double spur gear (73) enabling a conversion from a helical toothing to a straight toothing.

11. A printing unit according to claims 6, 7, 9 or 10, in which the forme cylinders (3 to 3.3; 4 to 4.3; 19; 19.1) on the side opposite the drive side are each provided with a lateral register control gear (37; 37.1; 38; 38.1; 79) effecting their axial displacement.

12. A printing unit according to claims 7 and 10, in which the helically toothed cylinder spur gears (66; 67; 72) of the forme cylinders (3 to 3.3; 4 to 4.3; 19.1) are arranged axially displaceably to effect a circumferential register adjustment of the respective forme cylinder (3 to 3.3; 4 to 4.3; 19.1).

13. Printing unit according to any preceding claim, in which of the two transfer cylinders (5 to 5.2; 6 to 6.2) of the four-cylinder printing unit (1 to 1.2) only one transfer cylinder (6 to 6.2) is pivotable for the printing-on and -off modes of the cylinder, the printing material web (7; 7.1) looping around the pivotable transfer cylinder (6 to 6.2) in the printing-on configuration (14) in such a way that in its

printing-off configuration (15) it runs without contact between the two transfer cylinders (5 to 5.2; 6 to 6.2).

14. A printing unit substantially as described herein with reference to any of the embodiments shown in the accompanying drawings.

The Patent Office

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Claims searched: 1-14

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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): B6C(CBHE,CCBC,CCBD)

Int Cl (Ed.6): B41F-009/18;13/16;27/06;27/10

Other: ONLINE: WPI,CLAIMS,EDOC,WPIL

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	EP0196018A2	(MAN ROLAND)	1 at least
X	US5381734	(Heidelberger Druckmaschinen AG)	"

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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